

CLAIMS

1. Method for the protection against leakage currents generated in the supply of a load (16) connected to an electrical network (10), comprising in combination the phases of:
 - generating and detecting a pre-established test leakage current, thereby verifying the efficiency and/or the calibration of the detection of the leakage currents;
 - detecting the actual leakage currents and generating a signal proportional thereto,
 - acquiring said proportional signal and disconnecting the load (16) from the electrical network (10) when reaching a dangerous condition corresponding to an acquired signal of a magnitude greater than a limit value.
2. Method according to claim 1, wherein the phases of verifying the efficiency and/or the calibration are performed before connecting the load (16) to the network (10).
3. Method according to claim 2, wherein said phases of verifying the efficiency and/or the calibration are performed by generating a test leakage current, generating a corresponding signal proportional thereto and verifying that such a signal be comprised in a pre-established range.
4. Method according to claims from 1 to 3, wherein before connecting the load (16) to the network (10) a zero-reference value of the proportional signal is obtained, by acquiring one or more times said proportional signal without generating test leakage currents.
5. Method according to claim 4, further comprising the phase of performing averaging operations to obtain a more reliable estimation of the zero reference value.
6. Method according to claim 4, wherein the limit value is obtained by taking the absolute value of the difference between the zero-reference-value and the magnitude of the acquired signal (90u) after generating the test leakage current, with the load (16) disconnected from the network (10).
7. Method according to the preceding claims, further comprising the phase of cyclically verifying, after the connection of the load (16) to the network (10), the regular detection of leakage currents by generating at least a test current.
8. Method according to claim 7, further comprising the phase of disconnecting the load (16) from the network (10) whenever, during the phase of cyclical verifying of the regular detection of leakage currents, the maximum in modulus of the magnitude

of the acquired signal (90u) is greater than the sum of the limit-value and the magnitude of the acquired signal (90u) acquired after generating the test-leakage-current with the load (16) disconnected from the network (10).

9. Method according to any of the preceding claims, wherein the detection of leakage currents is performed with a differential transformer (30) comprising a primary winding formed by conductors (12, 14) supplying the load (16) and a secondary winding (32) for generating said signal proportional to leakage currents.

10. Method according to claim 9, wherein the phase of disconnecting the load (16) is performed with an electrically controlled switch (20), which disconnects the load (16) from the network (10) when it is open and connects the load (16) to the network (10) when it is closed.

11. Method according to claim 10, wherein during a dangerous condition the electrically controlled switch (20) is forced open until the same switch (20) is disconnected from the network (10).

12. Method according to any of the preceding claims, further comprising the phase of detecting the current in at least a conductor connected to the load (16) and disconnecting the same load (16) whenever said current is greater than a pre-established threshold.

13. Method according to claim 12, wherein the phase of detecting the current in at least a conductor connected to the load (16) is performed before and/or after the connection of the load (16) to the network (10).

14. Method according to claims 12 or 13, wherein the detection of the current in at least a conductor connected to the load (16) is performed by means of a current transformer.

15. Method according to claims from 12 to 14, wherein the disconnection of the load (16) is performed by means of said electrically controlled switch (20).

16. Apparatus (1) for performing the method according the preceding claims, comprising

— an electrically controlled switch (20) set between the network (10) and the load (16), which disconnects the load (16) from the network (10) when open and connects it when closed;

- detecting means (30) for leakage currents that generate a signal proportional to the same leakage currents;
- an elaboration unit (50) connected either with the detecting means (30) for leakage currents to acquire said proportional signal, or with the switch (20) to drive its opening with a control signal (38) whenever a dangerous condition is met;

characterized in that it comprises a generator circuit (40) to generate a test leakage current, thereby verifying the efficiency and/or the calibration of the detecting means (30) and of the switch (20).

17. Apparatus according to claim 16, characterized in that the generator circuit (40) is controlled by an elaboration unit (50) through at least a control signal (36).

18. Apparatus according to claims 16 or 17, wherein the switch (20) is a relay with energizing coil (21) controlled by a control signal (38) coming from the elaboration unit (50).

19. Apparatus according to the preceding claims, wherein the elaboration unit (50) is a microcontroller.

20. Apparatus according to the preceding claims, further comprising a circuit generating a stabilized power supply for said elaboration unit (50), said circuit being supplied from the electrical network (10).

21. Apparatus according to the preceding claims, supplied by a single-phase ac voltage.

22. Apparatus according to the preceding claims, wherein the detecting means (30) for leakage currents comprise a differential transformer (30) having a core on which there are provided a primary winding constituted by conductors (12, 14) supplying the load (16), and a secondary winding (32) which generates a signal proportional to the current flowing into the primary winding.

23. Apparatus according to the preceding claims, wherein the generating circuit (40) comprises a resistor (86) in series with a triac (88) whose conduction is controlled by a signal (36) generated by the elaboration unit (50), said series shunting the conductors (12, 14) supplying the load (16) with a terminal downstream and a terminal upstream the detecting means (30).

24. Apparatus according to the preceding claims, wherein downstream the detecting means (30) for leakage currents there is provided an amplifier (90) for the signal proportional to said currents.
25. Apparatus according to claim 24, further comprising a circuit generating a stabilized power supply (91, 92) for the amplifier (90), said circuit being supplied from the electrical network (10).
26. Apparatus according to the preceding claims, wherein said elaboration unit (50) drives visual (112, 114) and/or acoustical warnings.
27. Apparatus according to the preceding claims, wherein said elaboration unit (50) is provided with timing means (28, 29) adapted to scan the cyclical control of the magnitude of the leakage current before and/or after the make of the switch (20).
28. Apparatus according to the preceding claims, wherein said elaboration unit (50) is provided with an arithmetic module adapted to compare the value acquired by the detecting means (30) for leakage currents with pre-established or acquired in real time values.
29. Apparatus according to claim 28, wherein said pre-established values are stored in a ROM inside the elaboration unit (50).
30. Apparatus according to any of the preceding claims, characterized in that it further comprises detecting means (300, 3001) for currents in at least a conductor connected to the load (16), said means (300, 3001) generating a signal proportional to said currents and being connected to said elaboration unit (50) to control the tripping of the switch (20) when a dangerous condition is met.
31. Apparatus according to claim 30, characterized in that said detecting means (300, 3001) for currents in at least a conductor connected to the load (16) comprise a current transformer.
32. Apparatus according to claim 30 or 31, characterized in that said elaboration unit (50) is connected either to said detecting means (300, 3001) for currents in at least a conductor connected to the load (16) or to the switch (20), in order to control the tripping of the switch (20) with a control signal (38) when a dangerous condition is met.

33. Electrical appliance provided with a plug (55) for connecting the appliance to an electrical network (10), characterized in that it comprises a protection apparatus (1) according any claims from 16 to 32.

34. Appliance according to claim 33, being a hair-dryer or any other household electrical apparatus.

35. Socket for supplying electrical appliances, comprising a protection apparatus (1) according any claims from 16 to 32.